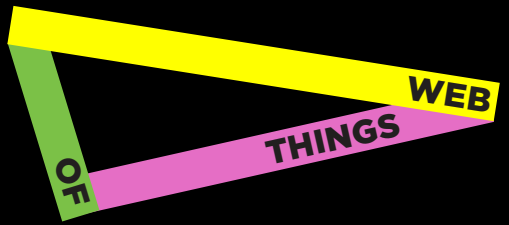
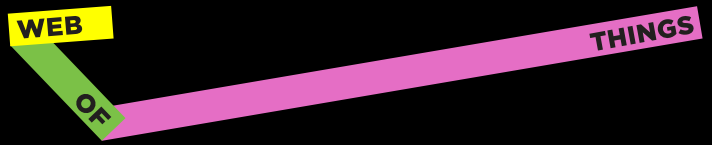
Dr. Dominique Guinard
CTO & Co-founder
BCS, 12.05.15

# BUILDING THE WEB OF THINGS

For the past 10 years, one layer at a time, one million things at a time...





Smarter products
come with EVRYTHNG

# Company Overview

| | |
|---|---|
| Model: | B2B Enterprise level Platform as a Service |
| History : | Launched in 2012 |
| Founders : | Highly experienced technology leaders,<br>Specialized Web-of-Things technologists (MIT / ETH) |
| Team : | 50 people and growing at speed (London, New York, San Francisco) |
| Key Investors : | ATOMICO BHLP CISCO DAWN CAPITAL SAMSUNG VENTURE INVESTMENT |

## Serving global brands that require SCALE

Coca-Cola GE AVERY DENNISON Domestic & General NIKE iHome Live Life Loud Mondelēz International gsk GlaxoSmithKline DIAGEO Gooee

# Market opportunity and inevitability

**83** Million cars

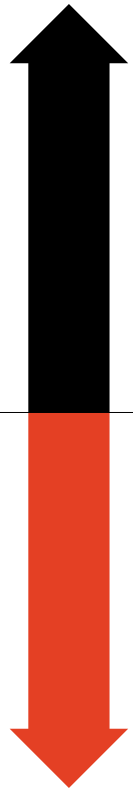
**2.3** Billion computing devices

**6.0** Billion RFID chips

**19** Billion microcontrollers


**80** Billion apparel items

**5-10** Trillion consumables

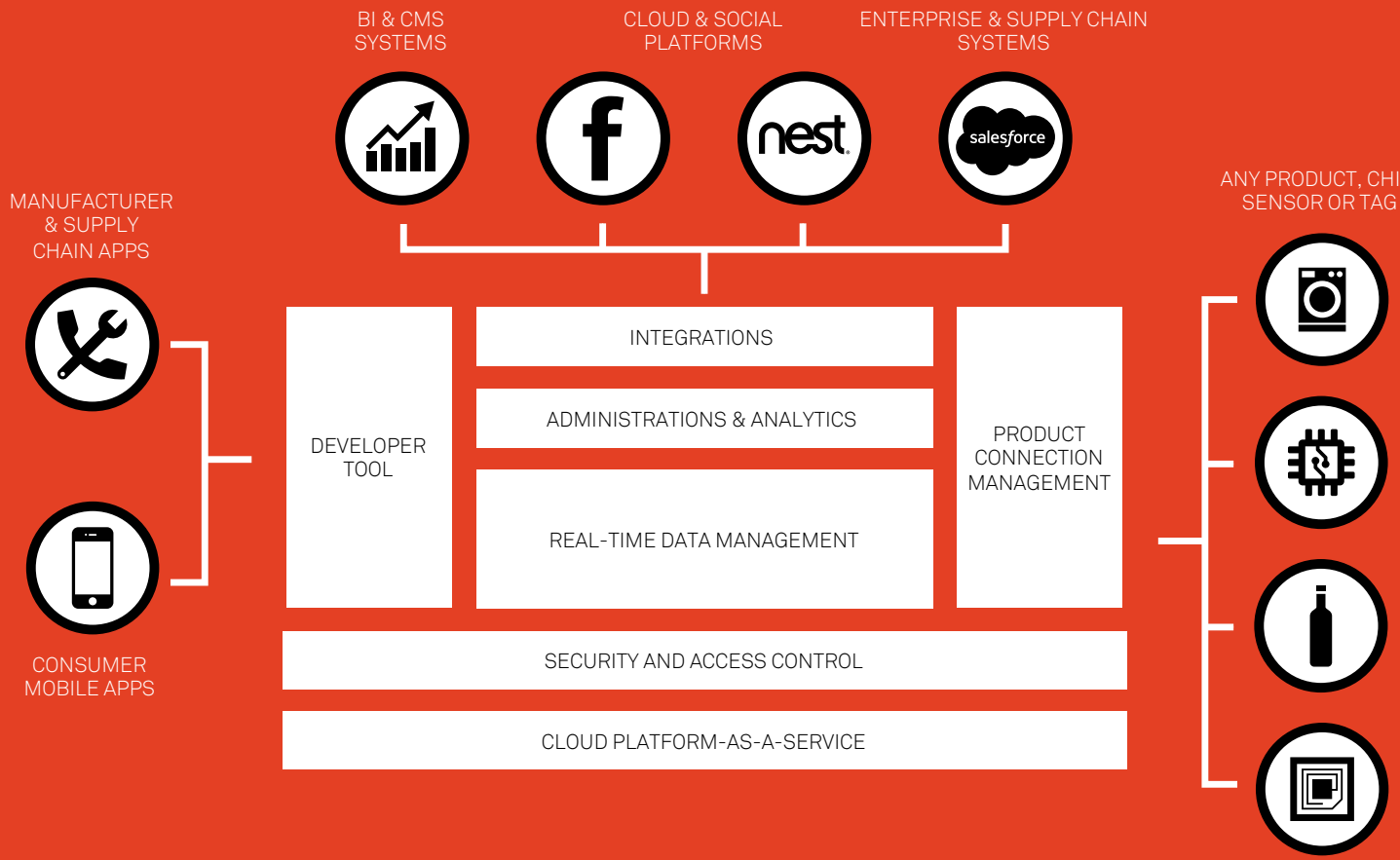


**Source: ThinFilm** (IDC; Gartner; World Bank; IMF; HIS; The Semiconductor Industry Association; OICA; IC Insights; Market Line; Apparel Market; Planet Forward; Companies & Markets)

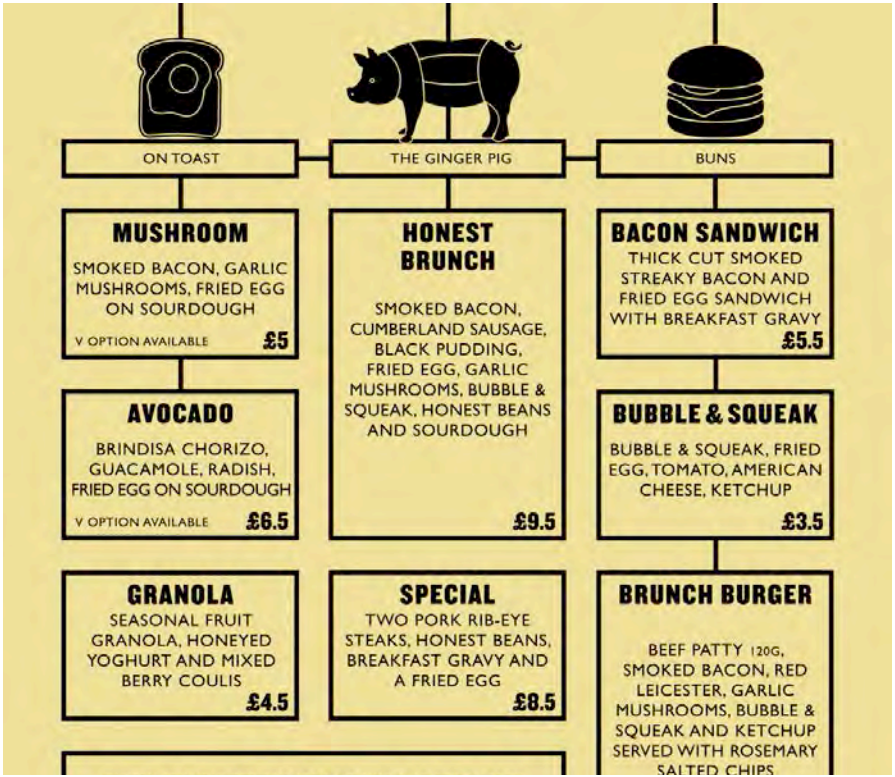


3

# EVRYTHNG - Smart Products Platform



# Today's menu

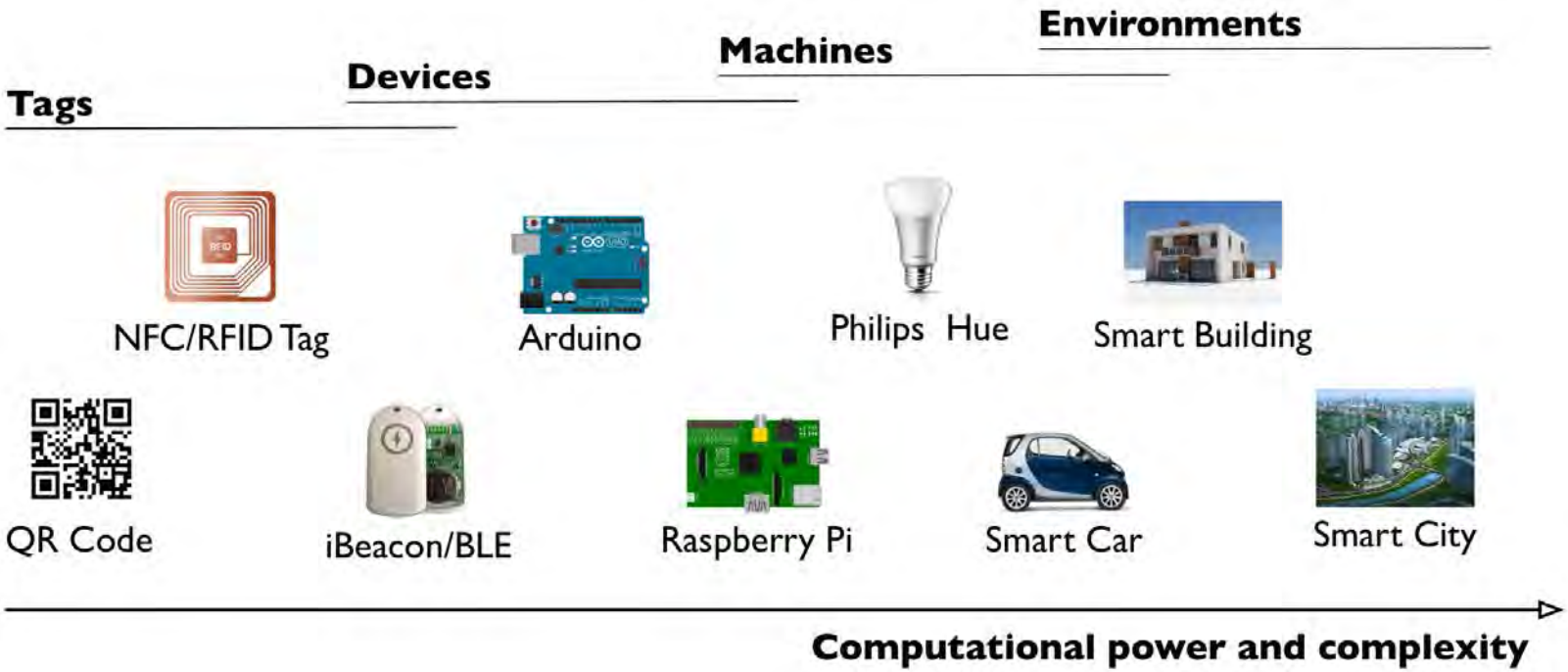



- From IoT to WoT
- Building the Web of Things
  - Layer
  - Discussion
  - Case-study @ EVRYTHNG

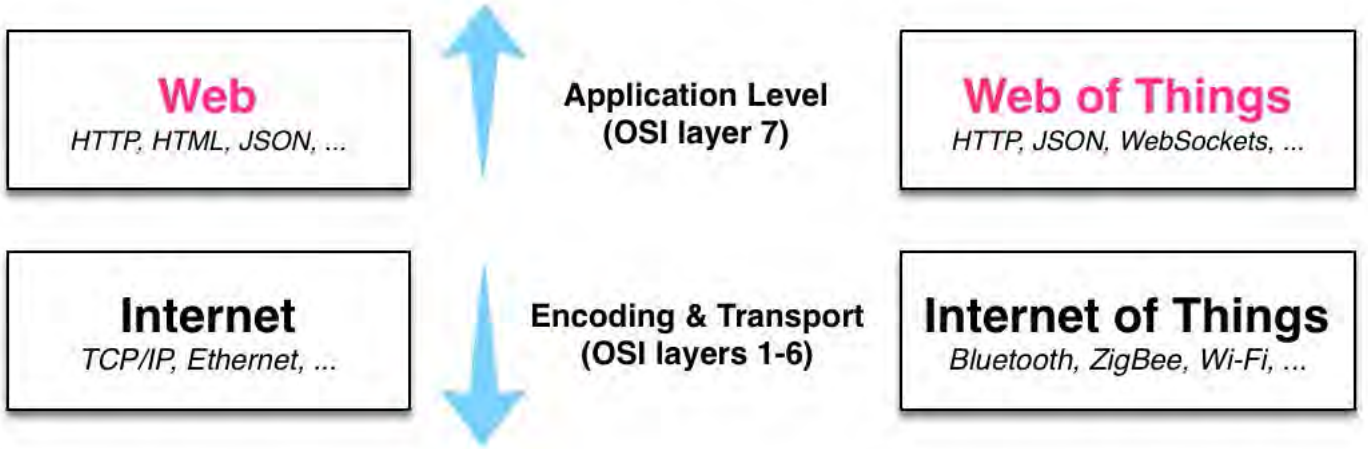
# From IoT to WoT

Bootstraping the Web of Things

# What are the Thing in the IoT?

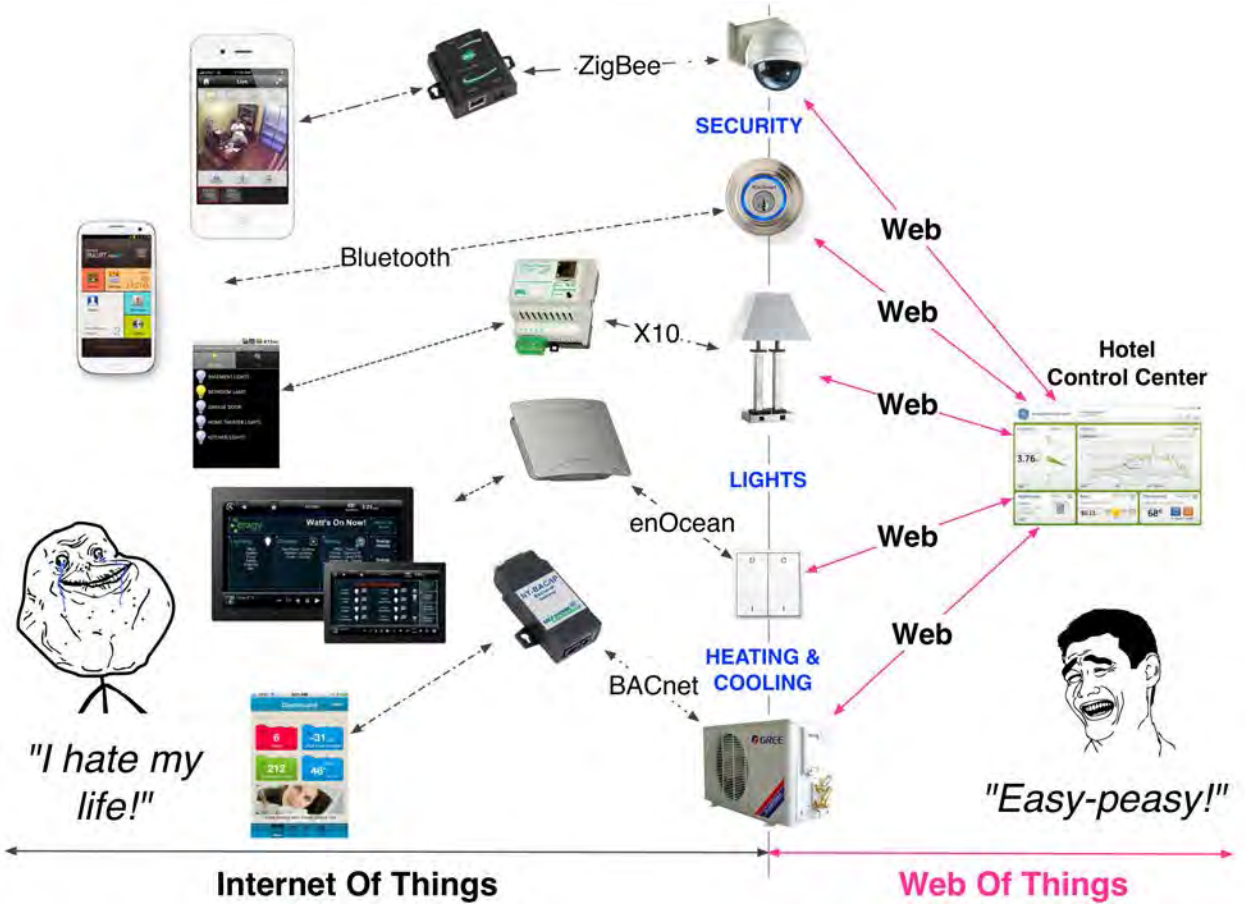


# The Web of Things: The IoT Application Layer




**Research Question:** *«How can the Web be leveraged to ease the development of Internet of Things applications and bring it closer to non-specialists?»*

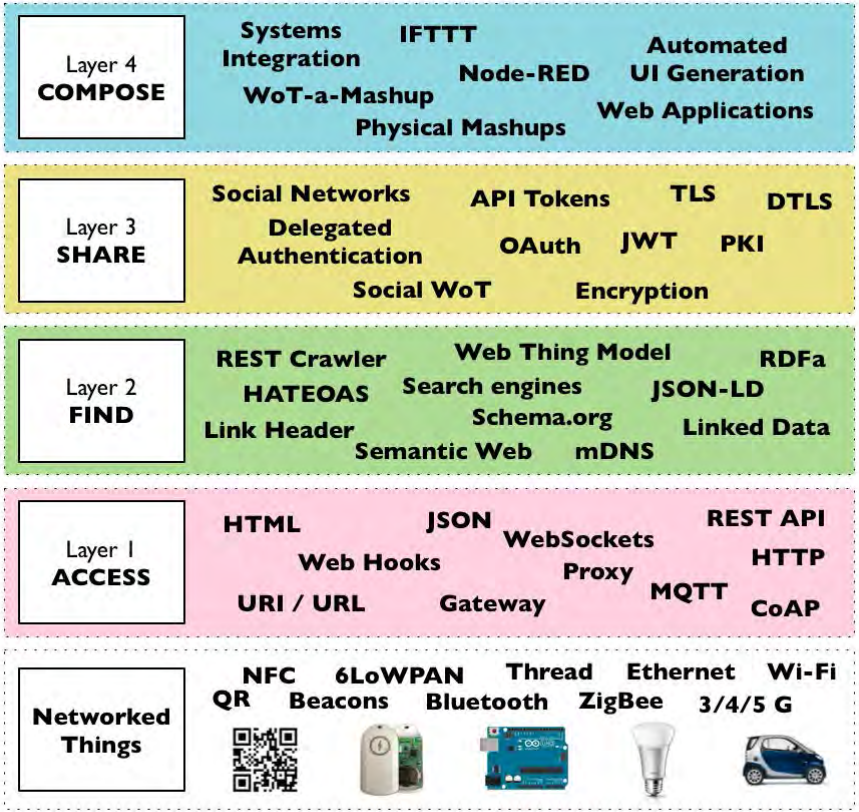
# The Web of Things vs the IoT



# Building the Web of Things

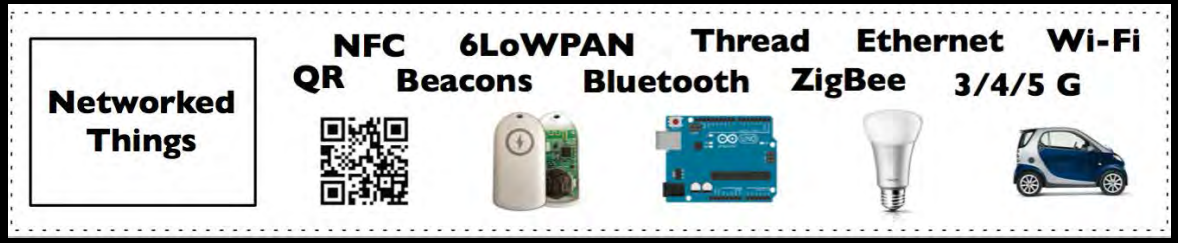
Layer by Layer

# The Web of Things Architecture

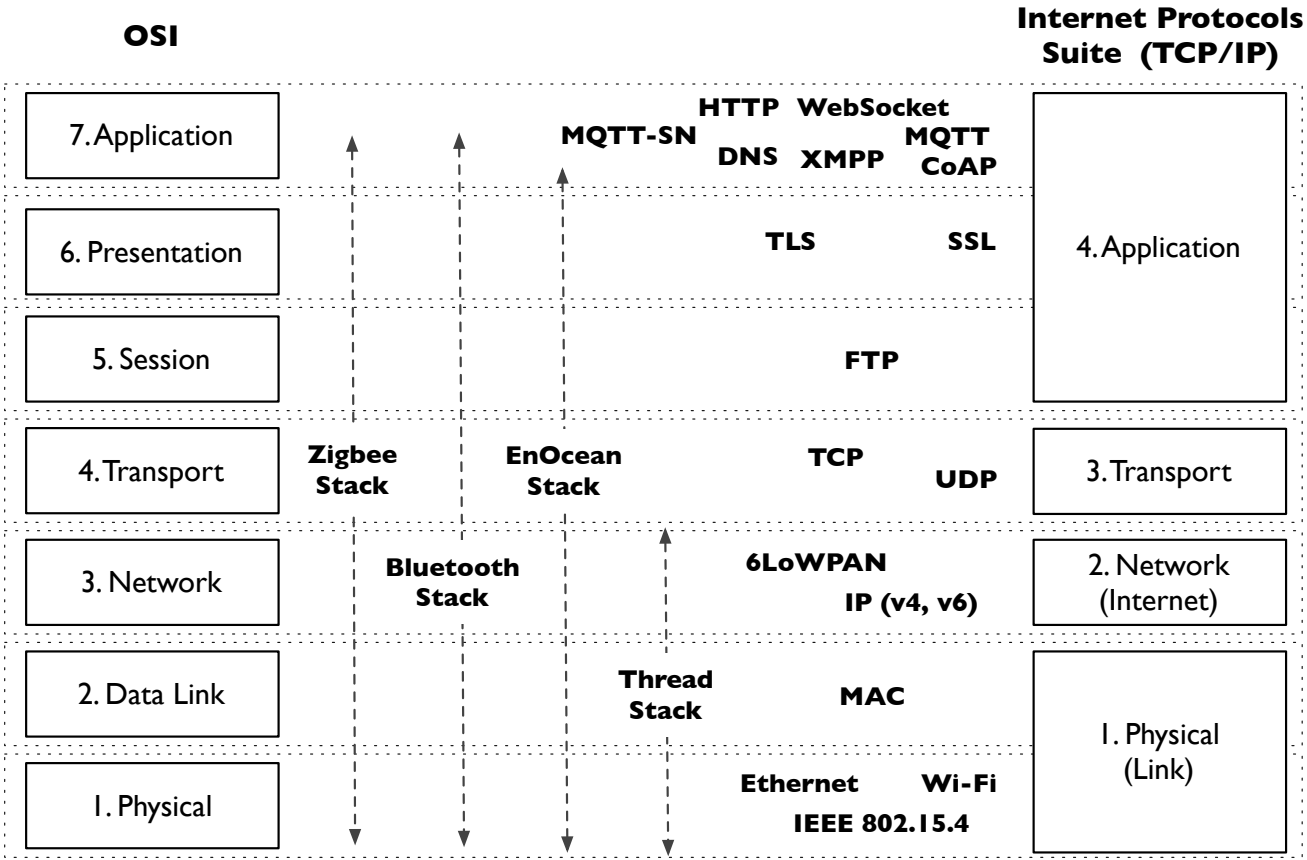



Source: Building the Web of Things: book.webofthings.io

# 0. The Network



# 1. Choose a Physical Protocol



# 2. Choose a Network Protocol: IPv4 VS IPv6, 6LoWPAN

## IPv4 Address

146.200.15.222

8 bits

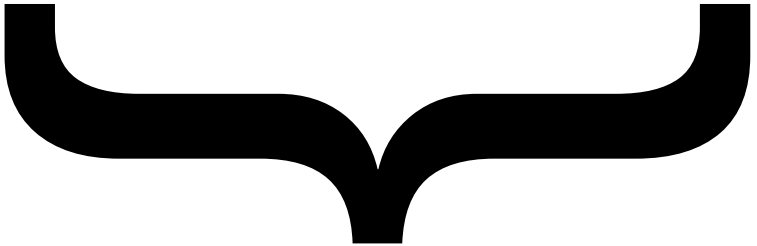
4 x 8 bits = 32 bits

$=2^{32}$ = ~4.3 billion addresses

## IPv6 Address

2001:db8:0:1234:0:567:8:1

16 bits



8 x 16 bits = 128 bits

$= 2^{128}$ addresses

# 3. Choose a Transport Protocol: TCP vs UDP

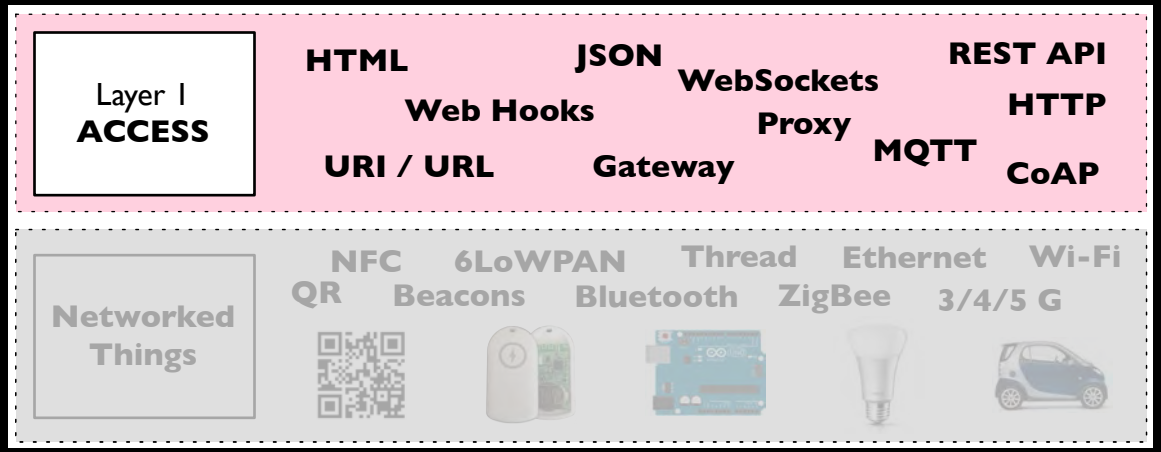
# Dom Perignon Button


- Get Champagne at the click of a button
- Drop it in a room!
  - Thick walls
  - Wi-Fi requiring browser login
- 2G – SMS connectivity

# Discussion: Layer 0 – The Network

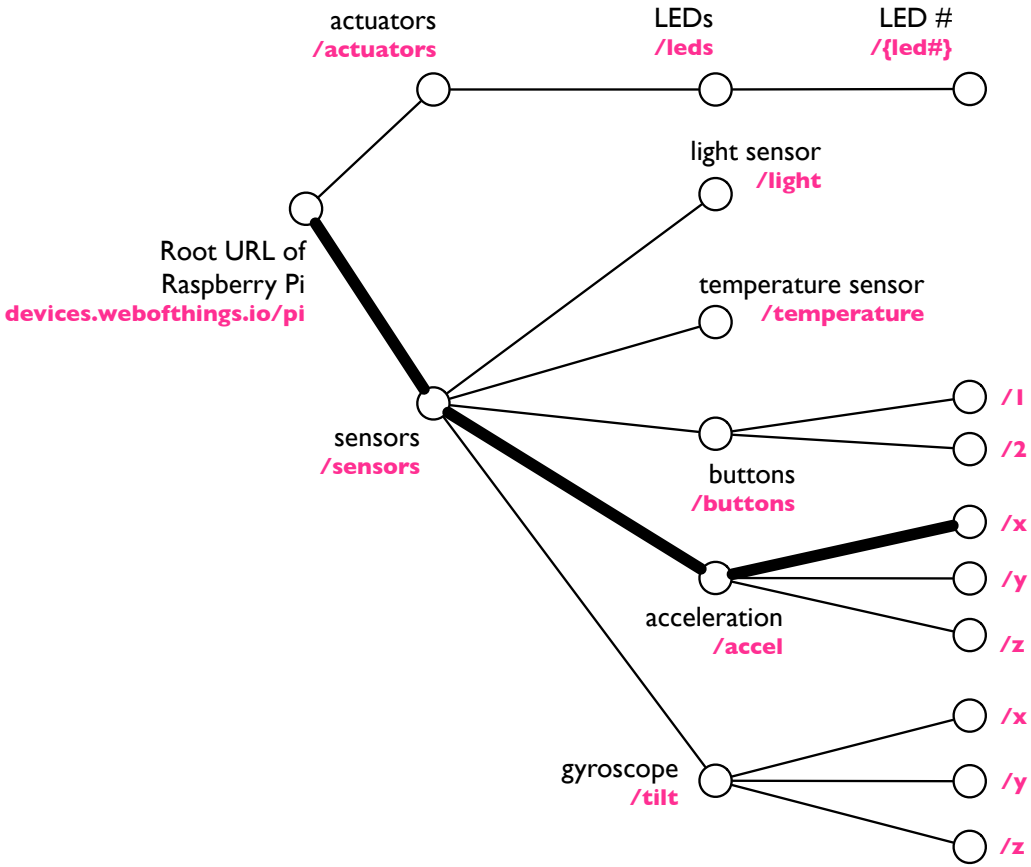
- Fragmentation needs to be resolved to fulfill the promise of the IoT!
- There will **not** be one protocol to rule them all!
  - Power consumption & battery power
  - Environment of a deployment
- Convergence to Internet Protocols
  - IPv6 (6loWPAN, TCP/UDP)
- Consolidations will take place (and need to!):
    - PAN: Zigbee 3.0 – Thread - Wi-Fi HaLo
    - LPWAN: SigFox – 5G
- Pick the simplest path:
  - ~10 years for routers to be rolled out

# 1. Access Layer



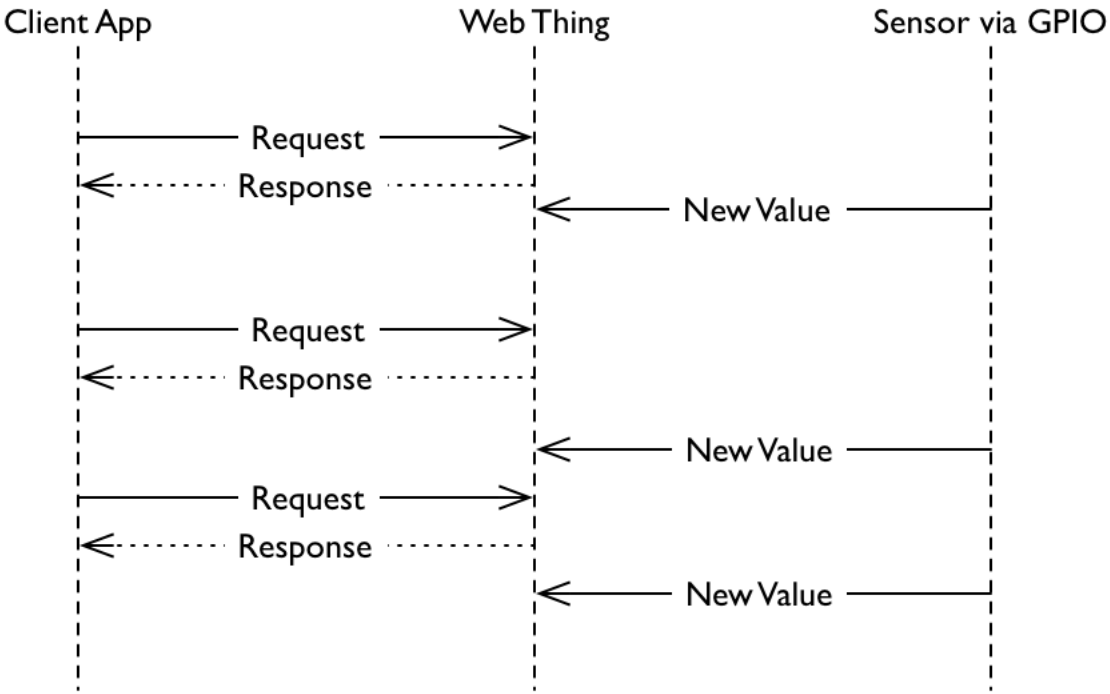
# Basic principle: a URL for each Thing

# And a RESTful API

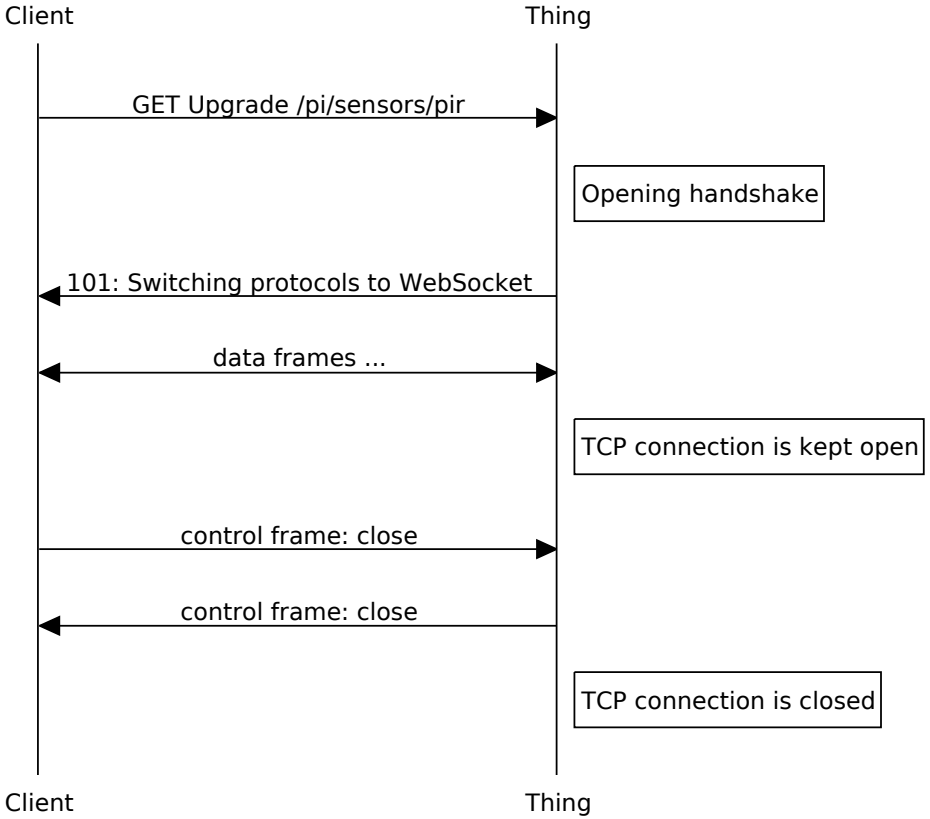



Demo!

# The real-world is event driven

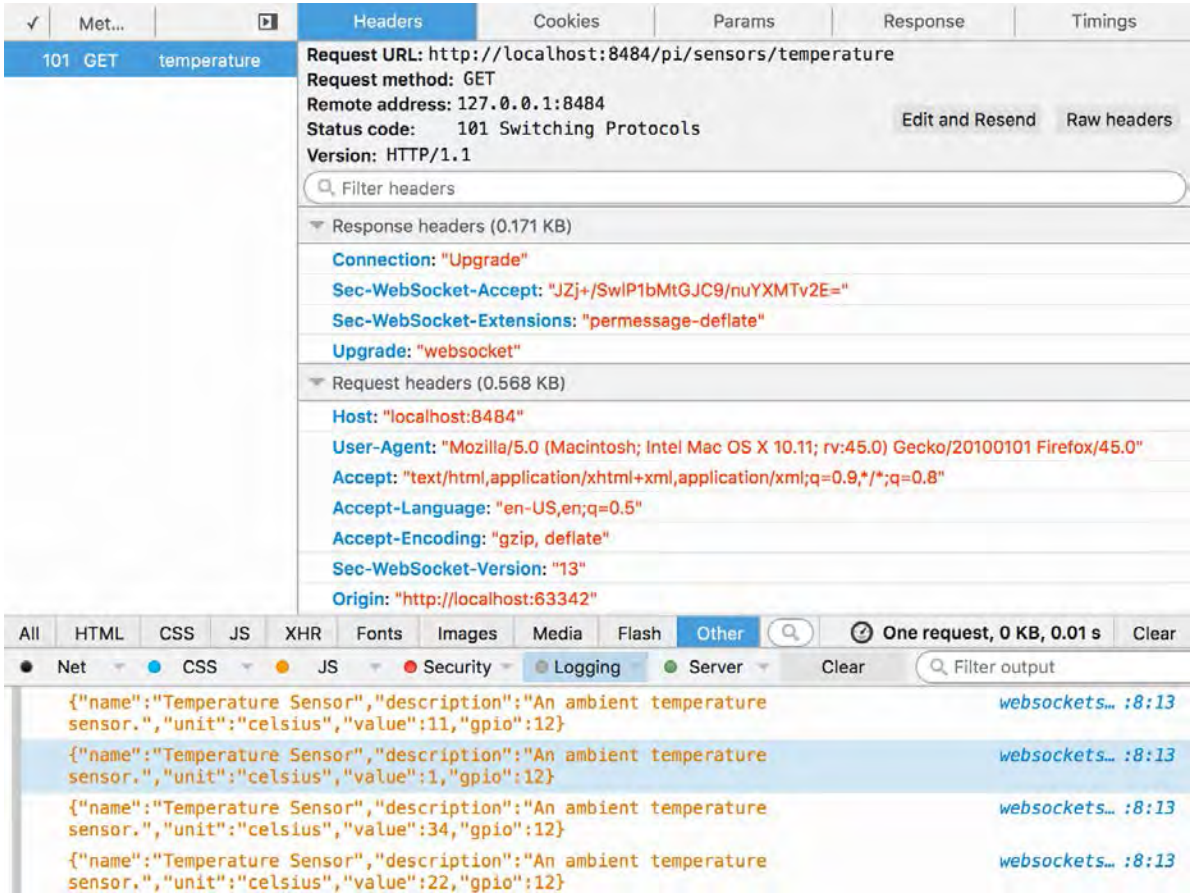


# The Web has WebSockets




Demo!

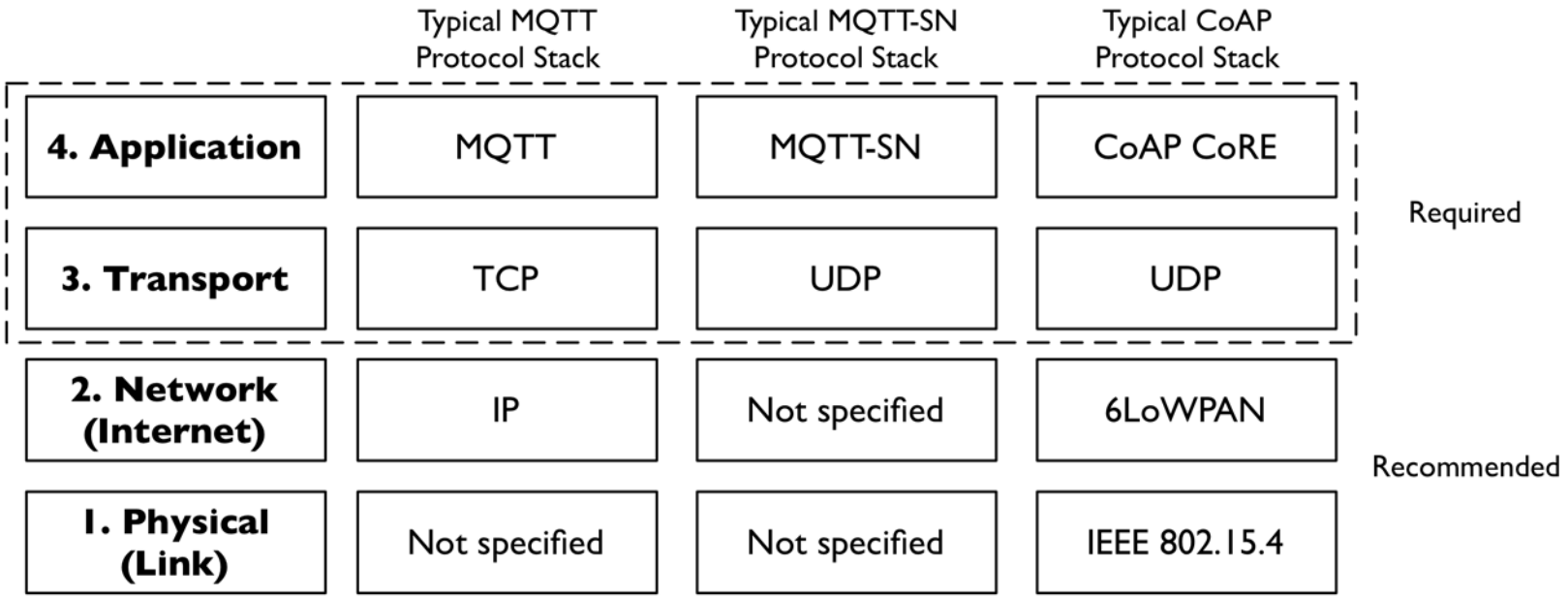
# WebSocket Upgrade in the browser



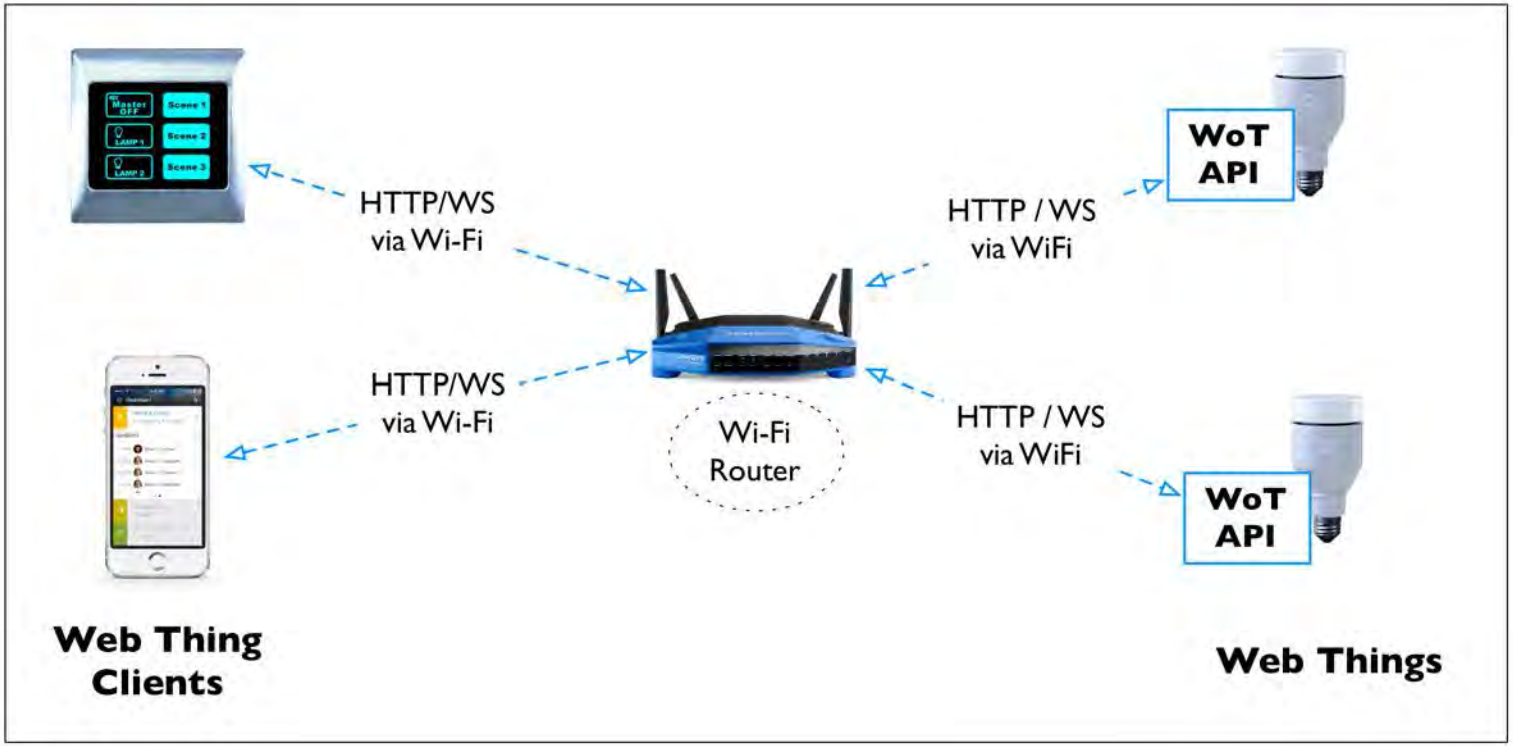
# Not all devices can speak HTTP and WebSockets, can they?


VS

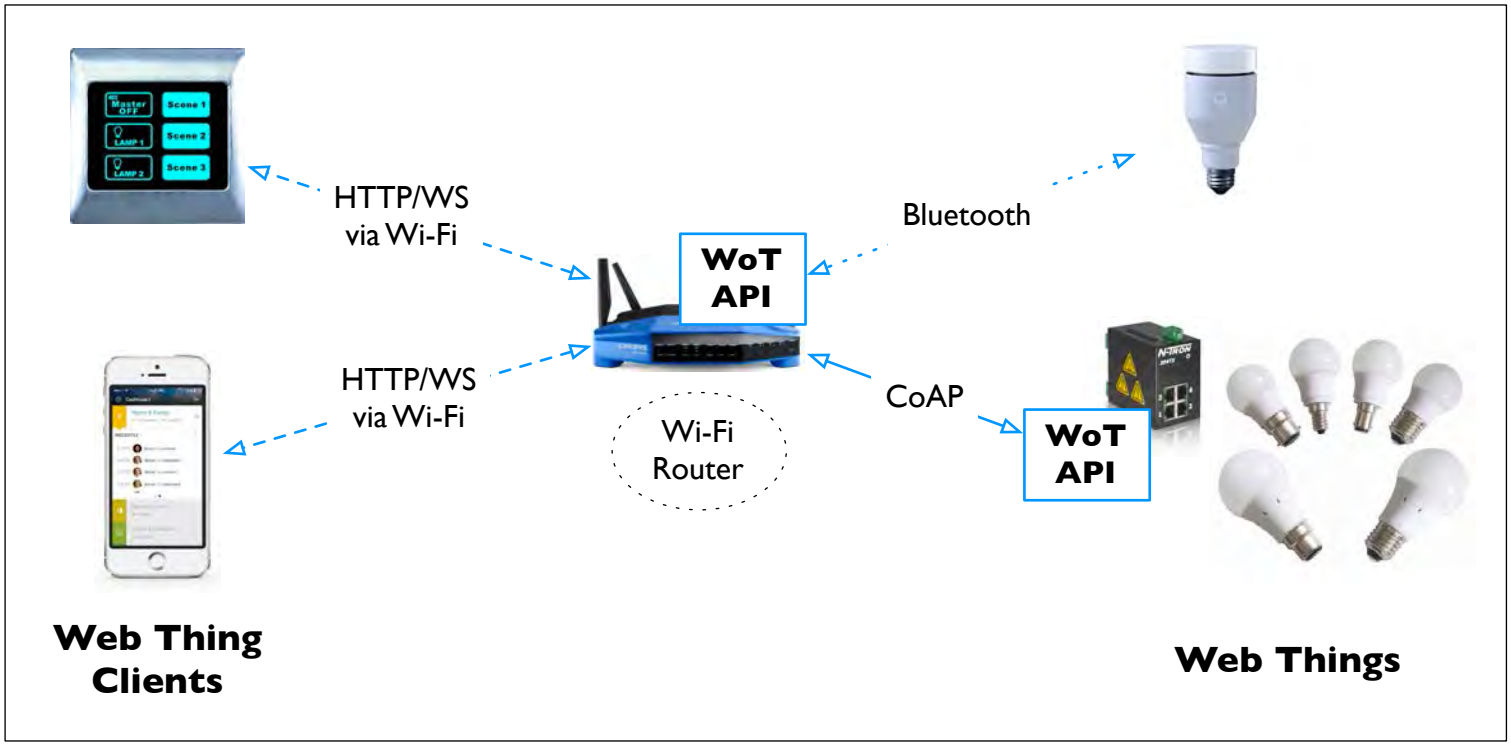

# Not all devices can speak HTTP and WebSocket



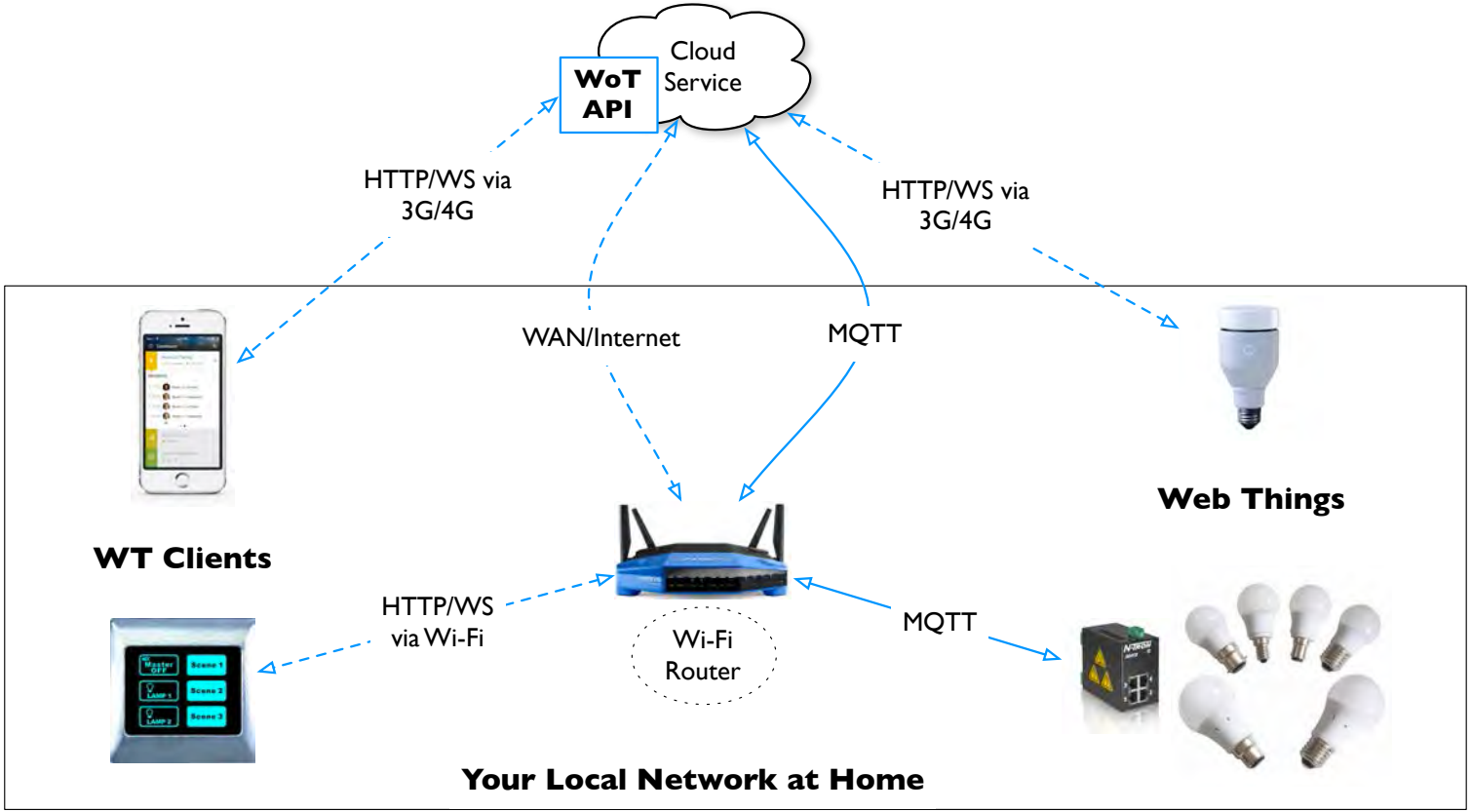
# Integration pattern: direct communication



# Integration pattern: Gateway



# Integration pattern: Cloud



# iHome – MQTT to Web Integration


iHome + EVRYTHNG

- iHome uses EVRYTHNG for their next-gen family of smart home products
  - Launched SmartPlug in July 2015, with suite of other products in development
  - One of just 5 initial HomeKit certified products
  - Uses out-the-box Marvell toolkit for devices with MQTT support
  - Integrated with SmartThings, Wink and Nest, and with iHome CRM and support system
  - Android and iOS apps for setup, creating scenes, timers and granting access to other users

Watch video

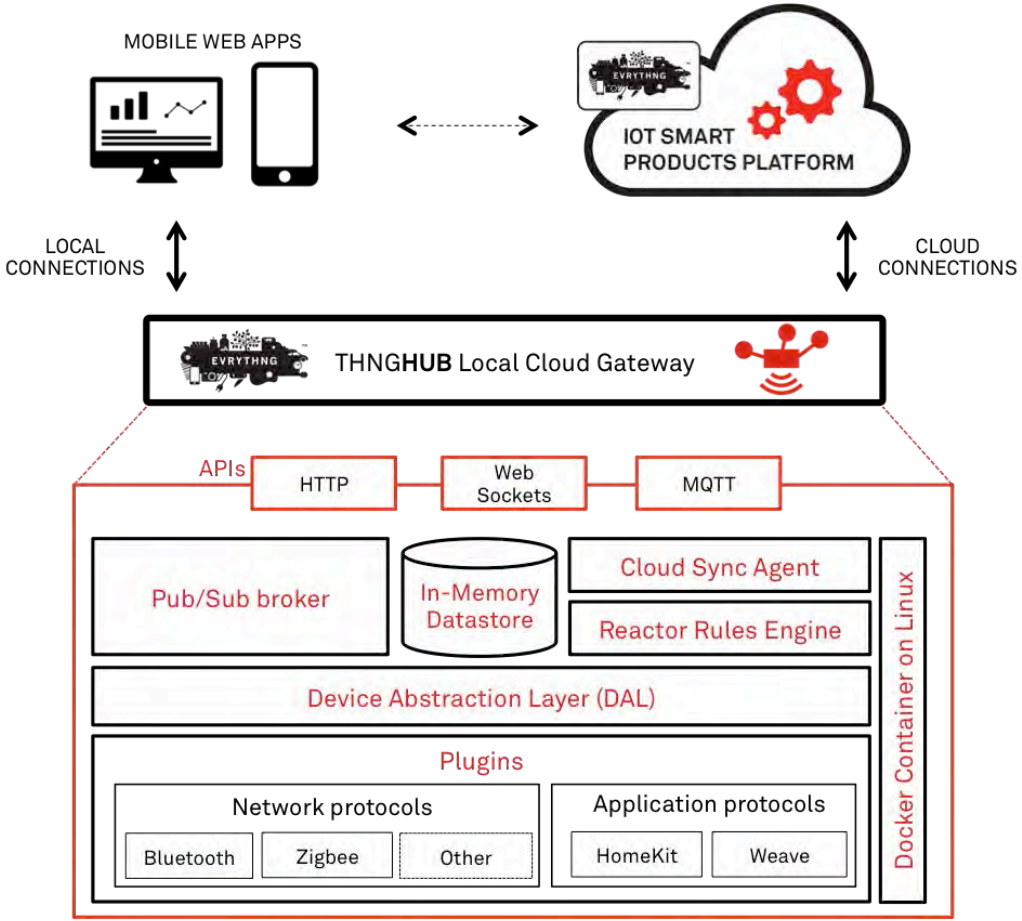
# Gooee – Gateway integration





- Gooee uses EVRYTHNG to sell Lighting-as-a-Service
  - Transforms dumb lights into smart services
  - Smart bulb for remote control, with motion sensors for retail traffic monitoring & security
  - Energy management & lower maintenance costs
  - Greater control and flexibility

# THNGHUB: a WoT Gateway




- Multi-protocol support including Zigbee, Bluetooth, WiFi, Ethernet
  - Modular protocols support via additional plugins
  - Any language (DAL)
- Local Web API via HTTP/REST, WebSockets, M2M API via MQTT
- Local version of EVRYTHNG's Reactor™ Rules Engine
- Runs on Linux (ARM or x86/64), supports most gateways architectures
- Deployed as secure, virtualized docker containers on any Linux appliance

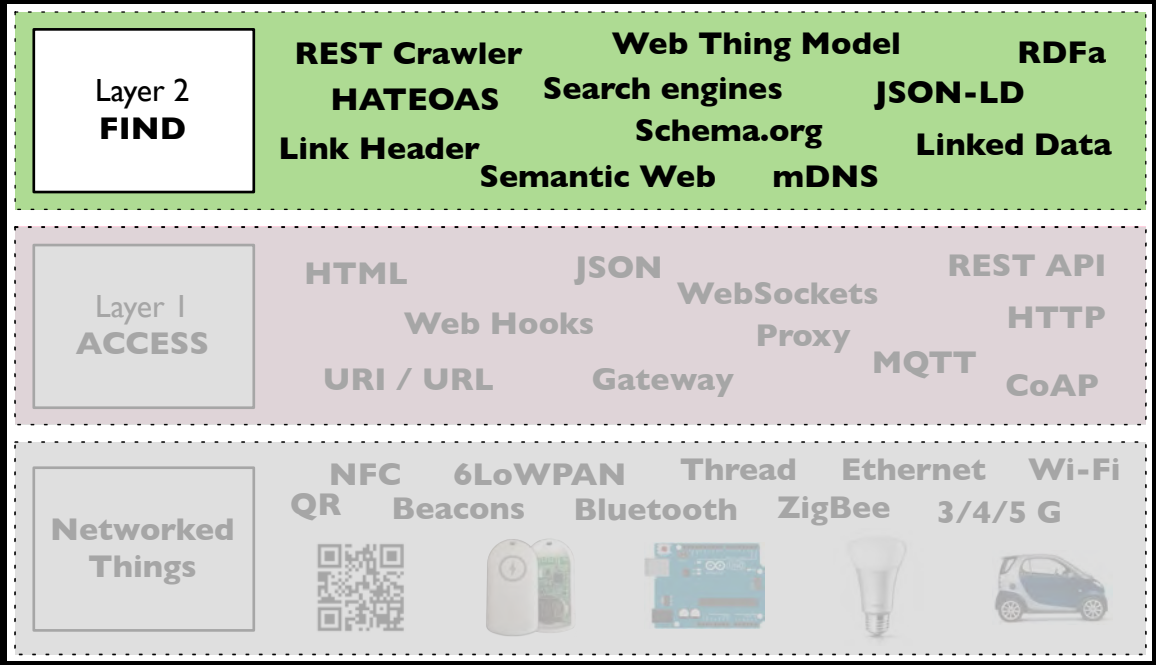
# IoT World's Largest Deployment


- 10 Billion products through Avery Dennison labels
- Apparel products are "born digital"
- Based on the simple concepts of URLs and Web API for each thing

# Discussion: Layer 1 - Access

- All protocols need to meet at the Application Layer
  - The Web
- Other protocols can be translated to HTTP/WS
  - MQTT (quality of service, remote actuation)
  - CoAP (battery, low power)
- Pick the simplest path:
  - Simplicity **does** matter!
  - UDP NAT traversal issues, etc.

# 2. Find Layer


Layer 2
FIND
REST Crawler
Web Thing Model
RDFa
HATEOAS
Search engines
JSON-LD
Schema.org
Link Header
Linked Data
Semantic Web
mDNS
Layer 1
ACCESS
HTML
JSON
REST API
WebSockets
Web Hooks
HTTP
Proxy
MQTT
URI / URL
Gateway
CoAP
Networked Things
NFC
6LoWPAN
Thread
Ethernet
Wi-Fi
QR
Beacons
Bluetooth
ZigBee
3/4/5 G

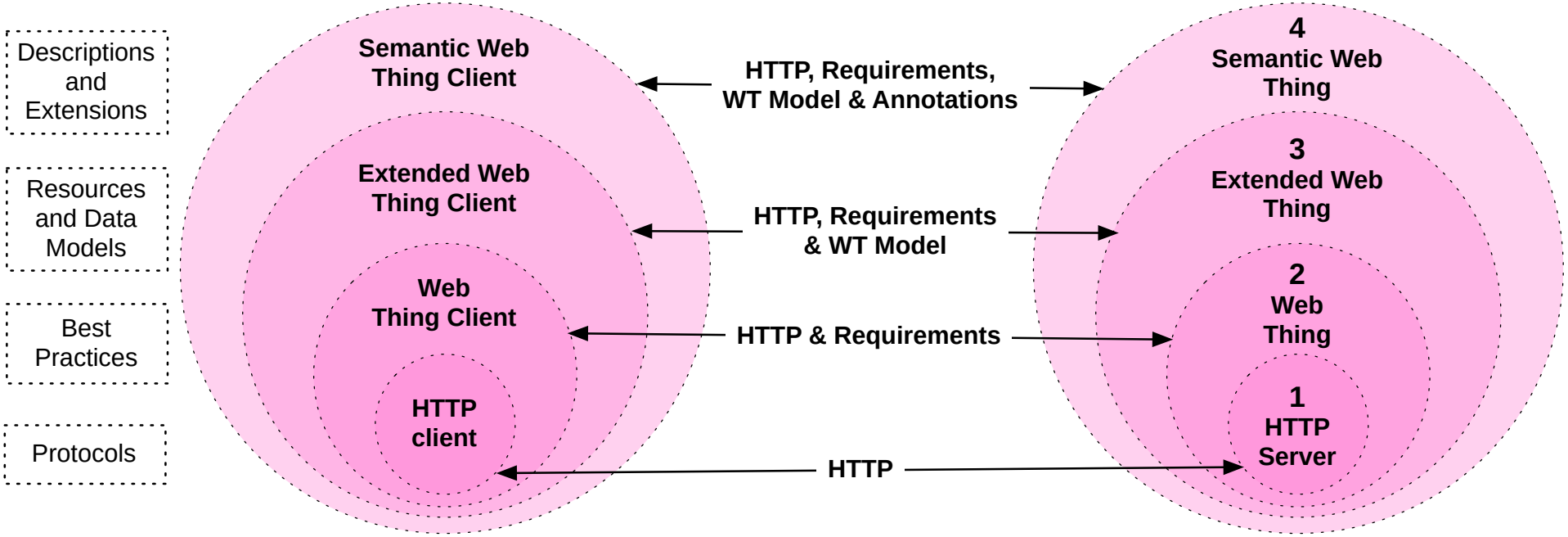
# Web Thing Model

W3C Member Submission

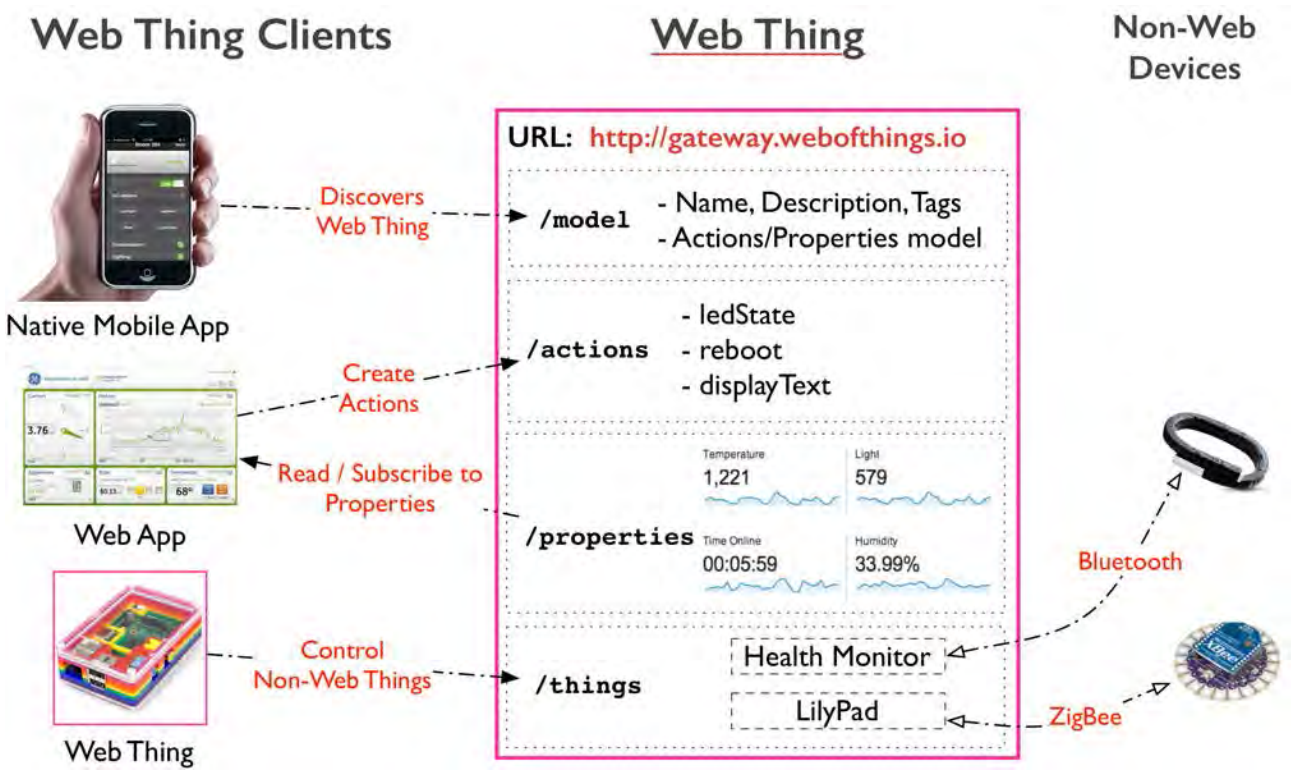
**Web Thing Model**

W3C Member Submission 24 August 2015

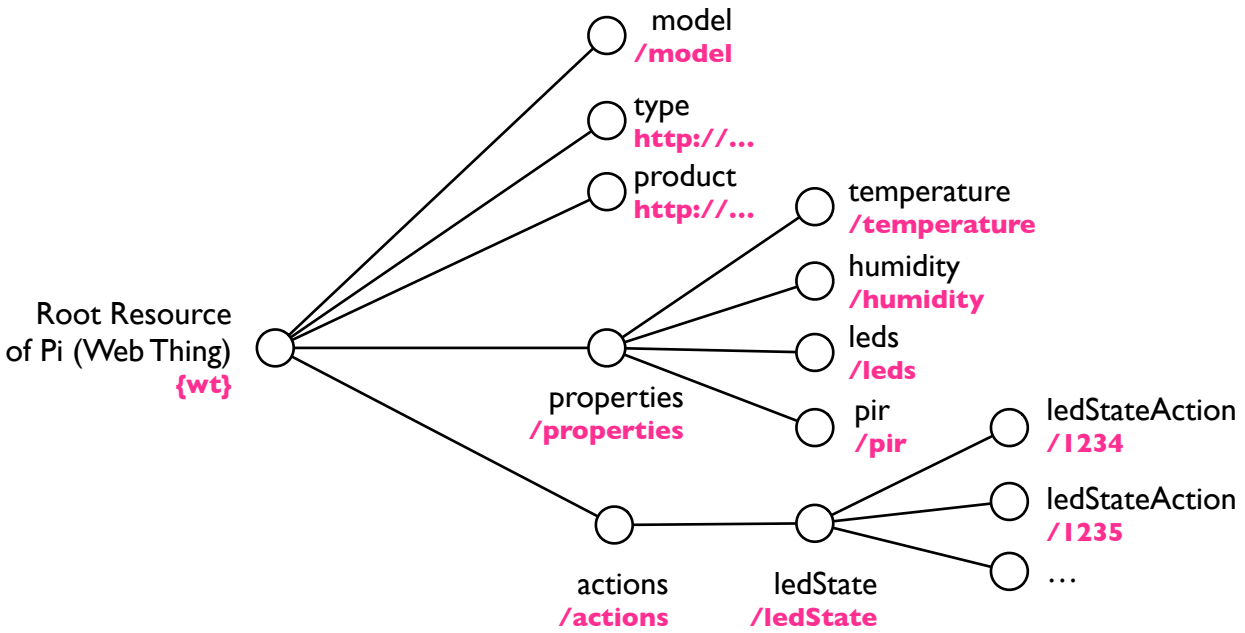
http://model.webofthings.io
http://gateway.webofthings.io



# Web Things Model

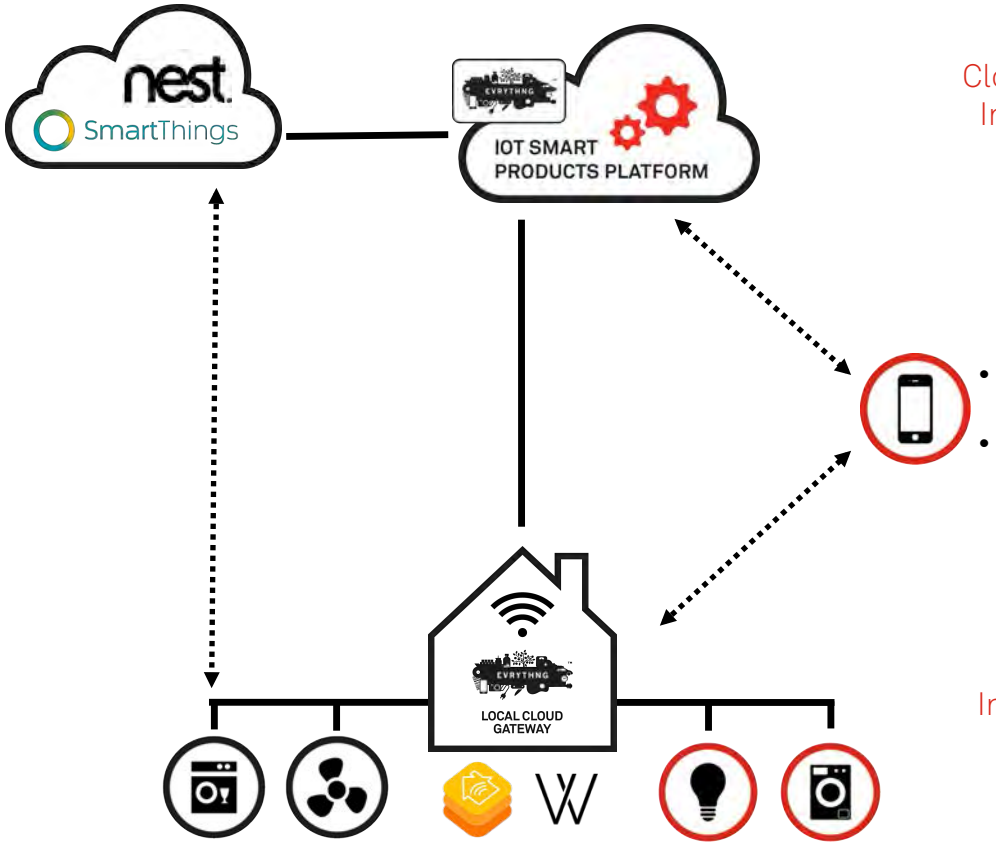


# An example




Demo!

# Semantic Smart Home Integrations




Cloud to Cloud Integrations

- iOS and Android compatible
- In & out of home control

Local Integrations

**Platform integrations** via Cloud to Cloud modules

- Enables devices to be managed by EVRYTHNG & accessible and controlled from 3rd party systems and apps. e.g. Nest, Wink or SmartThings

- Integration module includes:
  - User & device mapping
  - Synchronization
  - Custom Logic

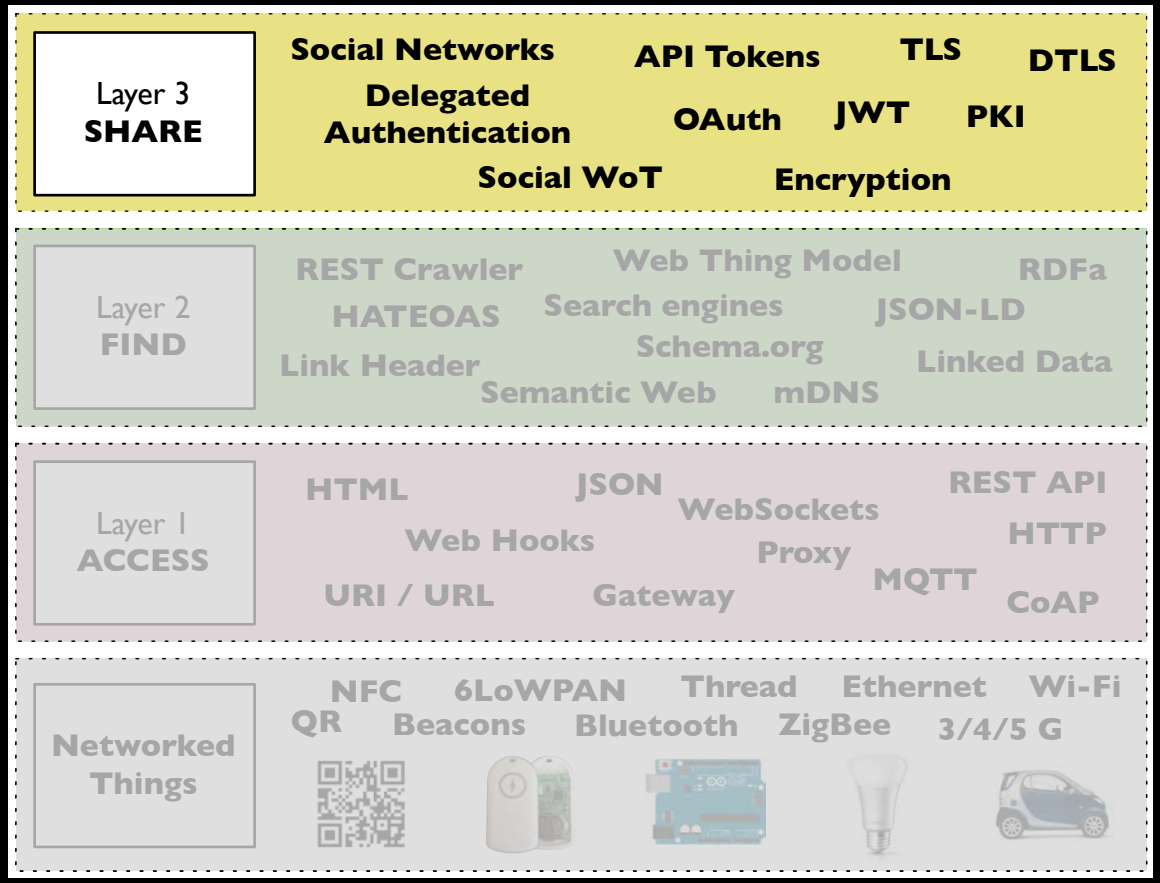
**Local integrations** via THNGHUB Local Cloud Gateway

- Enables interoperability with Homekit & Weave
- Connection to 3rd party products via device APIs

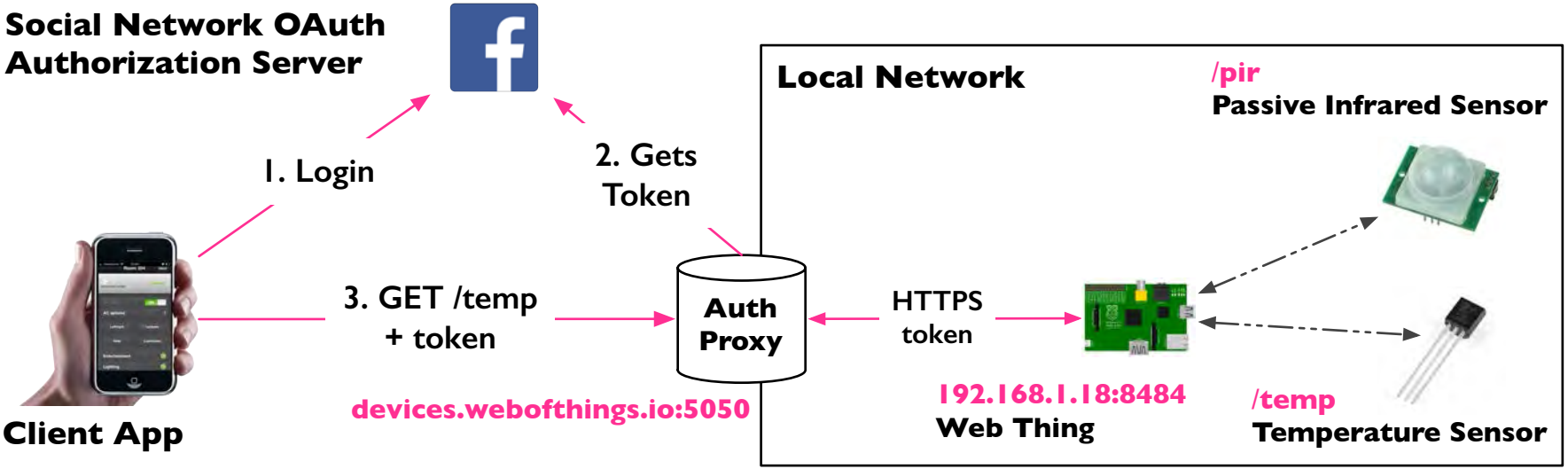
# Discussion: Layer 2 - Find

- Using Web protocols is the first step towards true interoperability
  - Helps “opening” devices, freeing them through APIs
- Web protocols cover the “How” not the “What”
  - Great for humans, challenging for machines
  - Semantic Web, JSON-LD
  - First W3C proposal for the Semantic Web of Things: http://model.webofthings.io
  - Schema.org
  - See also https://www.w3.org/WoT/IG/

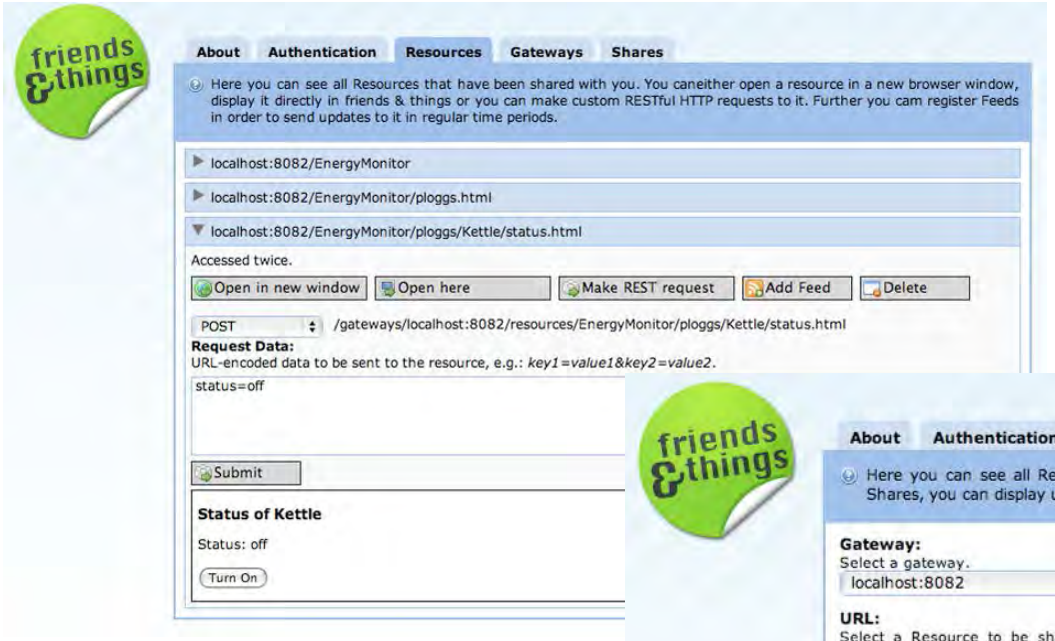
# 3. Share Layer

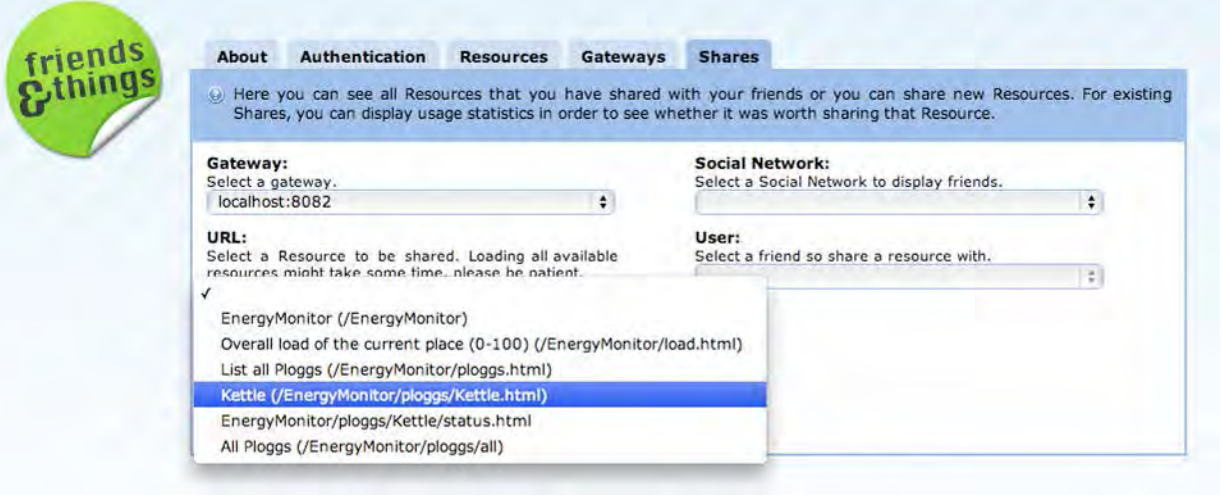


# The Social Web of Things



# Friends & Things

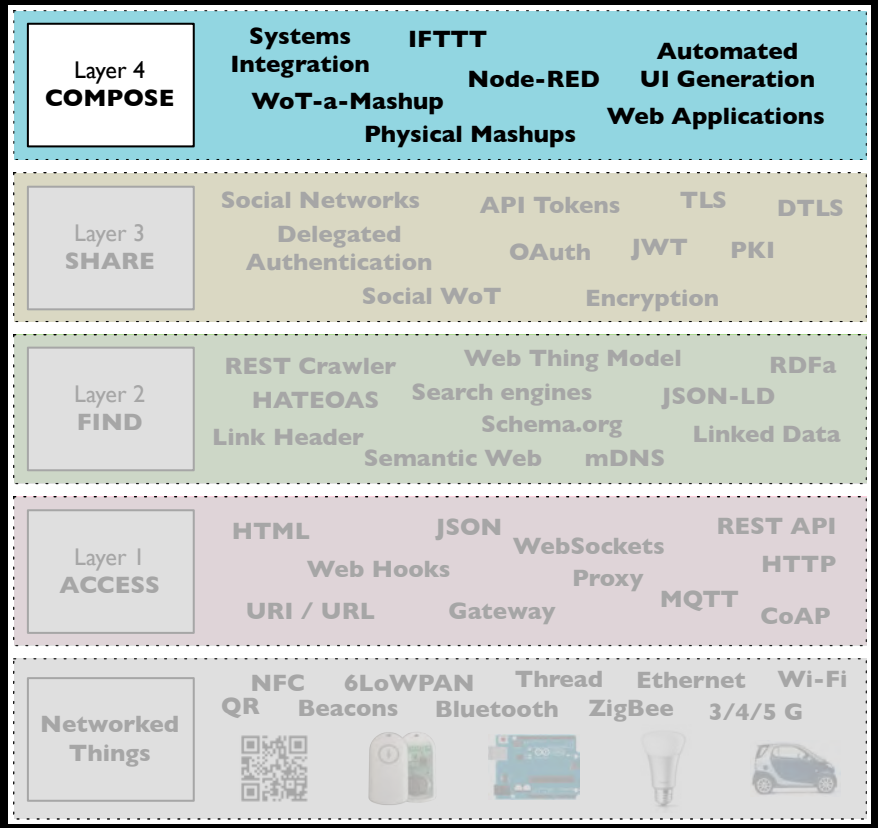


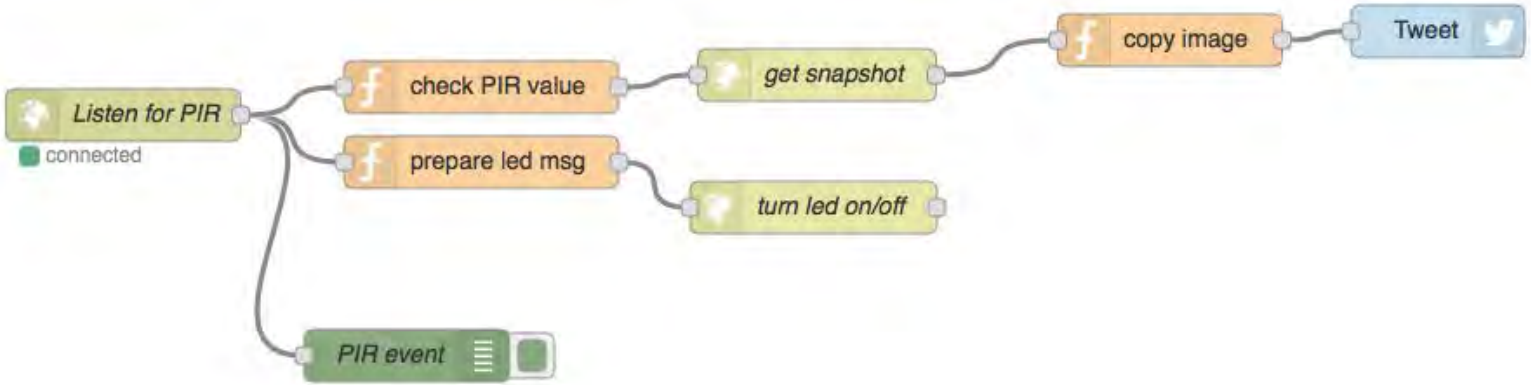
# Discussion: Layer 3 - Share

- Security by obscurity never helps
  - Better off with open protocols!
- Technical challenges
  - TLS can be heavy for resource constrained devices
  - See DTLS, TLS on UDP for constrained devices
- Things on the Web = Things on the Web!
  - DDoS attacks
  - UDP flooding / TCP SYN attacks
  - Hacking the physical world
    - E.g., Shodan, Baby Monitors

# 4. Compose Layer



# Composing the real-world: Physical Mashups




http://node-red.org

# Physical Mashups with IFTTT


New tweet by specific user
@wotbook

Make a web request

**Recipe Title**

If new tweet by specific user @@wotbook, then make a web request

use '#' to add tags

Turn off

Publish

Check now

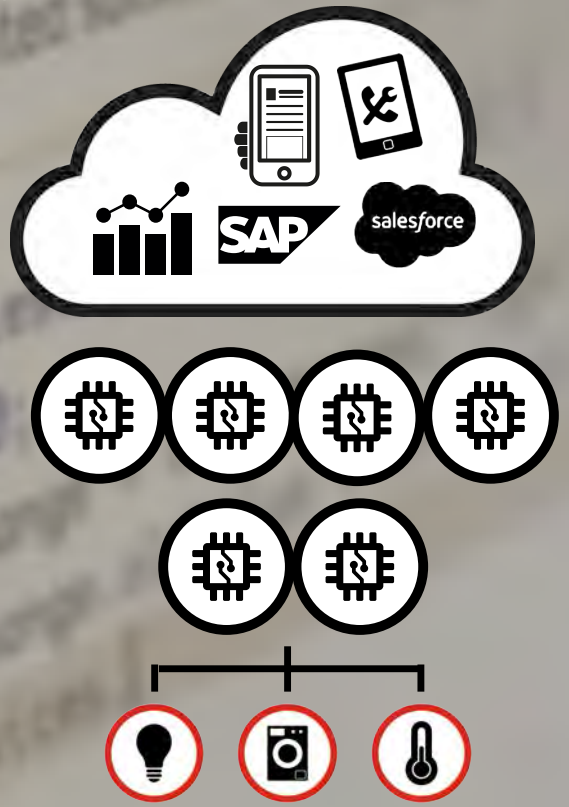
Log

Delete

created January 17, 2016
last run March 22, 2016
run 10 times

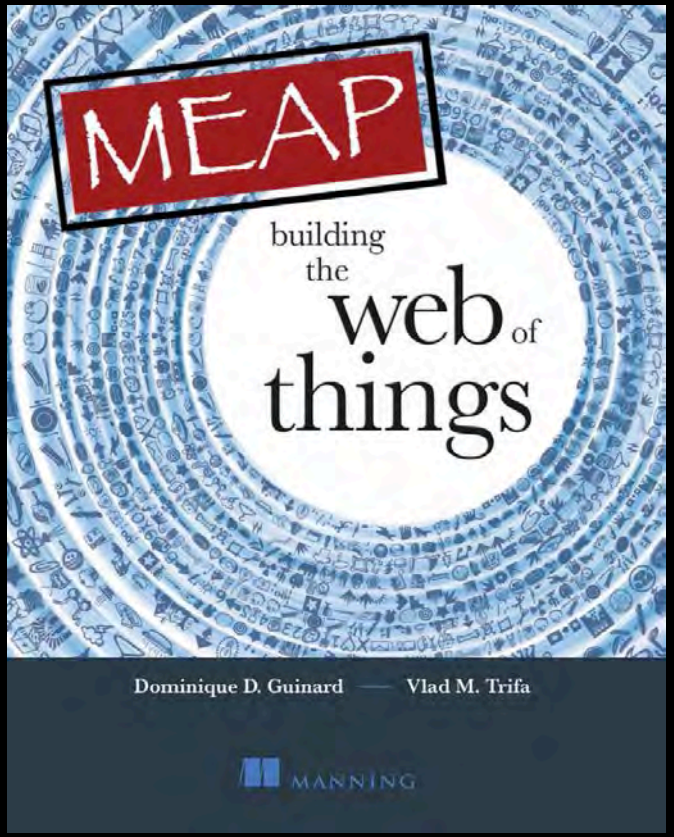
http://ifttt.com

# The Reactor

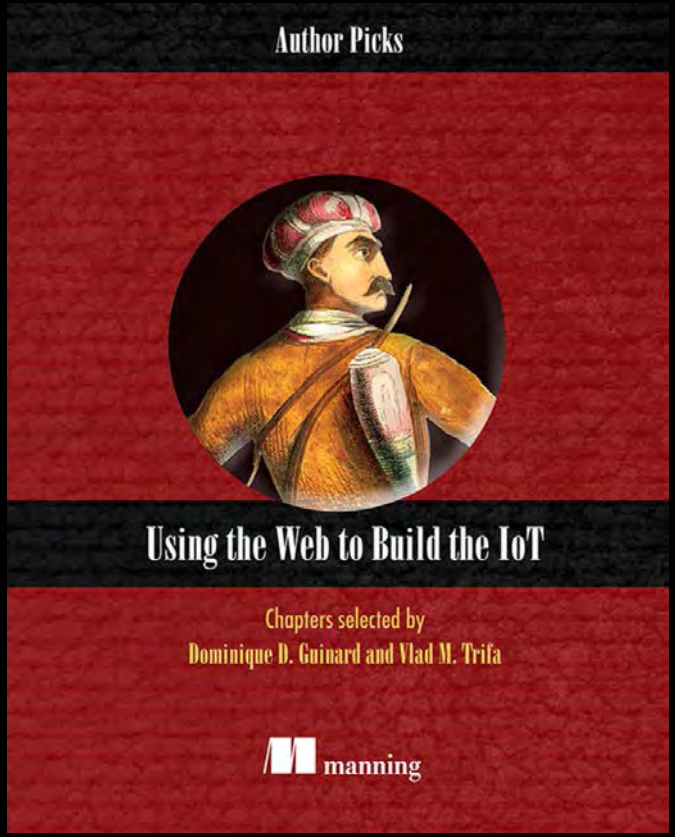



https://developers.evrythng.com/

- Usage: reacting to events
  - Generate alerts for users via apps, SMS, calls
  - Generate events in other systems
  - Physical mashups
- Massively scalable scripting run-time
  - Unlimited horizontal scale
  - Ephemeral virtual instances
- Secure
  - Data isolation
  - One event, one instance
- Flexible
  - Node.js runtime
  - Full NPM access




20% off “Building the Web of Things” with code “guid20evry”
See: http://book.webofthings.io




Free e-book with sample chapters